

# **A Manufacturer's Handbook for the Sustainable Use of Chemicals & Materials**



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Sustainable Research Group (SRG) provides research, project design, and project management services that advance a company's integration of sustainable development principles into its business model, thus reducing its ecological footprint, contributing to human health, and increasing its value proposition to stakeholders and the larger community.

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## Section I: Introduction

Welcome to *A Manufacturer's Handbook for the Sustainable Use of Chemicals & Materials* (the "Handbook"). The Handbook is an informative reference and tool set for business and manufacturing operations to develop a proper chemical management and hazard assessment protocol. The primary goal of the Handbook is to help the User: (i) identify the chemicals being used in its products, processes or facilities; (ii) screen these chemicals for potential negative impacts; and (iii) identify opportunities to replace any chemicals of concern with environmentally preferable alternatives.

### ***Whole System View of Chemicals***

To achieve its stated goal, the core concept behind the structure of the Handbook and the chemical assessment protocol is "know the chemicals". The quality (and thus the value) of the chemical assessment performed on a product (material), process or facility is limited by the quality and completeness of the body of knowledge of the chemicals present. This concept further recognizes that a complete and accurate picture of potential chemical concerns necessitates a whole-systems perspective. To achieve this perspective, the following elements were included in the design of the chemical assessment protocol: (1) consider not just the chemicals physically associated with the product (materials), manufacturing processes and maintenance procedures, but also the chemicals lost to the environment through air emissions, water discharges and waste generation; (2) do not limit the assessment to regulated chemicals - include an assessment of emerging chemicals of concern that are not yet regulated, but for which the weight-of-evidence is mounting; (3) recognize that chemicals can impact multiple life-cycle impact categories; and (4) recognize that chemicals can have different exposure routes and impacts at different life-cycle stages of a product.

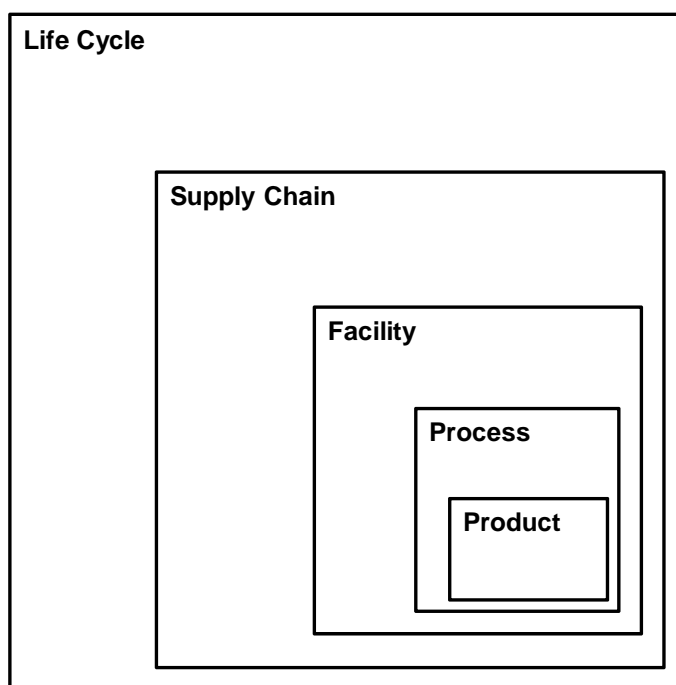
### ***Flexibility of Use***

The Handbook was deliberately designed to be flexible to anticipate several realities of the likely User: (1) companies will differ in the availability, completeness, and quality of chemical information; (2) companies may wish to perform an assessment at different levels (e.g. product, process, facility) or life-cycle stage (e.g. "gate-to-gate", "cradle-to-grave" etc.); and (3) companies may have different priorities with respect to environmental impacts (e.g. air emissions versus water emissions; global warming versus toxicity; human health versus ecosystem toxicity etc.).

Flexibility is achieved by making the Handbook and its tool-set primarily "input-driven" by the User; the Handbook is simply a step-by-step approach and set of tools to identify, collect, inventory, manage, and assess chemicals for a selected boundary. The Users set the scope and boundaries of the assessment, determine the quantity and quality of data inputted, and have control of all decision points (e.g. which human health and ecosystem health impacts to consider).

## ***Setting Boundaries***

The concept of boundaries is another core structural feature of the Handbook. The “basic unit” for the chemical inventory and assessment is the value stream. Figure 1 is a schematic depicting the different levels of assessment that can be achieved by specifying discrete boundaries. The User can set the boundaries of the value stream at any preferred level: a specific product (material), manufacturing process, or a whole facility. This modular approach also accommodates a life-cycle analysis of the chemical impacts of a product. Assessments can be performed independently for different value streams encompassing different stages in the life cycle of the product, and the results stacked to provide a more complete picture of the chemical impacts of the product. For example, you could work with your supply chain to complete chemical assessments (using this Handbook) of the materials you specify for your product.



**Figure 1: Scalable boundaries for different levels of chemical assessment**

It is important to understand that the chemical assessment protocol adopted in the Handbook is a qualitative approach based on hazard identification; it does not purport to be either quantitative or a full risk assessment. This does not minimize the value of the exercise. By first performing a hazard assessment of all the chemicals for a given value stream, the User can flag those potential chemicals of concern for a follow-up assessment of exposure potential and thus risk. In this way, chemicals of concern can be prioritized for reduction or substitution with safer, practical alternatives prior to expending the more significant costs of a full risk assessment. In other words, it provides a first level screening of potential chemicals of concern, setting the foundation (and management structure) for more thorough chemical assessments.

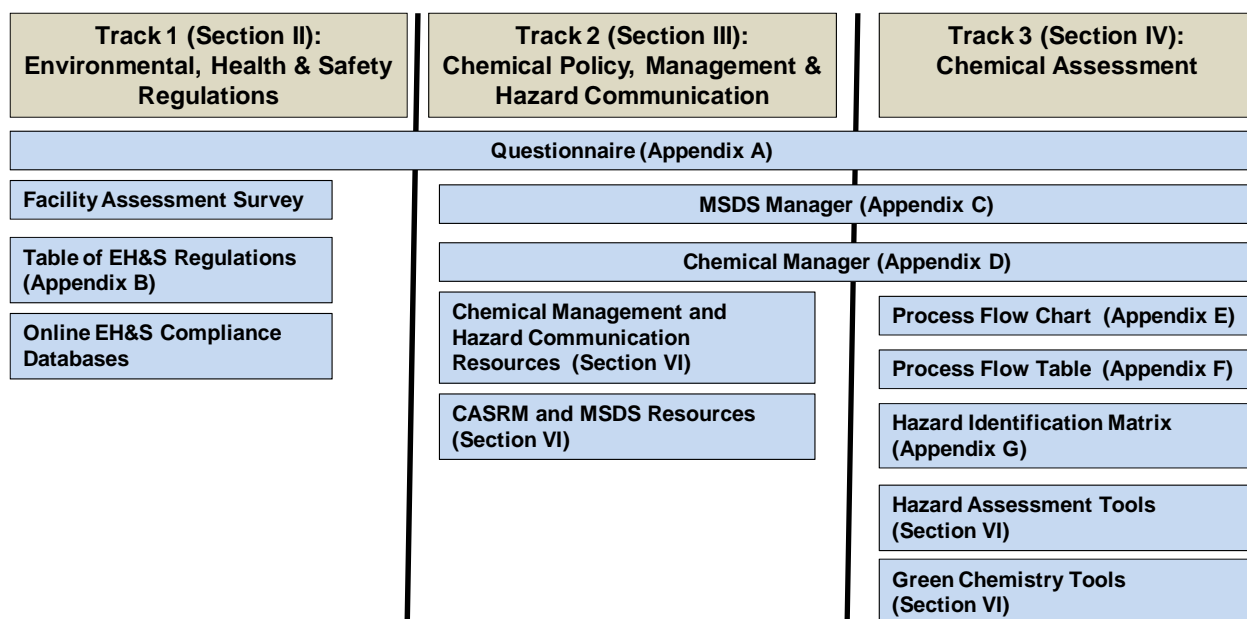
## ***Organization of the Handbook***

The structure of the Handbook is organized along three tracks. The first track is *Environmental, Health and Safety Regulations*, covered in Section II. This section of the Handbook helps a company: (i) identify all environmental, health and safety (EHS) regulations governing its operations at a local, state and federal level; and (ii) assess whether its operations are in compliance with these regulations. It also serves as a source of chemical information, especially relating to releases to air, water and land.

The second track is *Chemical Policies, Management, and Hazard Communication*, covered in Section III. This section of the Handbook helps a company: (i) evaluate the current state of its chemical policy statement, chemical management plan, and hazard communication plan; (ii) develop a system to effectively manage and communicate Material Safety Data Sheets; and (iii) develop a chemical inventory to identify and track all chemicals “flowing” through its facilities.

The third track is *Chemical Assessment*, covered in Section IV. This Section describes a step-by-step approach to (i) complete a qualitative chemical assessment based on hazard identification; and (ii) identify opportunities to replace chemicals of concern with more environmentally preferable chemicals. Key to this section is the setting of the boundaries for the value stream under consideration, and compiling all input and output chemical information flowing through the value stream. This Section is predominantly user-input driven, with the User controlling the scope and boundaries of the hazard assessment.

Completion of all three tracks is facilitated by step-by-step instructions on how to use the provided tools, which include a questionnaire, survey, MSDS Manager, Chemical Manager, process flow map, hazard identification matrix, chemical assessment resources and general resources. A figure summarizing the organization of the Handbook with respect to three main tracks and associated tools is provided in Figure 1. The tools are either provided in Appendices A through G or can be accessed on-line using the hyperlinks provided in Section VI (Resources & Reference Materials). Also note that Section V (Acronyms and Definitions) provides a list of definitions for key terms and acronyms used in the Handbook.



**Figure 2: Organization of the Handbook**



## Section II: Environmental, Health and Safety Regulations

This section of the Handbook helps a company: (i) identify all environmental, health and safety (EHS) regulations governing its operations at a local, state and federal level; and (ii) assess whether its operations are in compliance with these regulations.

To complete this Section, please follow Steps 1 through 3 described below:

### Step 1 Questionnaire

- Complete Section A (“Rules & Regulations”) of Appendix A
- Record here the number of “Yes” answers \_\_\_\_\_ / 9

👉 **Note:** The questionnaire is set up so that a “YES” answer reflects the ideal state.

👉 **Tip:** “NO” answers indicate areas for improvement.

### Step 2 Facility-Assessment Survey

- Complete the “Facility-Assessment Survey” section of the *Michigan Manufacturers’ Guide to Environmental, Health and Safety Regulations (Fifth Edition)*.

👉 **Note:** A web link to an on-line PDF version of the survey is provided in Resources & Reference Material Section.

### Step 3 Table of EHS Regulations & Reporting Requirements

- Record all applicable EHS regulations & permits that govern the company’s operations in a table.
- For each regulation, record the nature and frequency of reporting requirements

👉 **Tip:** Use pre-formatted table provided in Appendix B to record the regulatory information.

## Compliance History

- [illegible]

- YES ☐ NO ☐

- YES ☐ NO ☐

## Section III: Chemical Policies, Management and Hazard Communication

This section of the Handbook helps a company: (i) evaluate the current state of its chemical policy statement, chemical management plan, and hazard communication plan; (ii) develop a system to effectively manage and communicate Material Safety Data Sheets; and (iii) develop a chemical inventory to identify and track all chemicals “flowing” through its facilities. The term “flow” recognizes that chemicals may be inputs (e.g. used in products, manufacturing processes, or maintenance procedures) or outputs (e.g. lost to the environment in the form of releases air, water and land). Knowledge of what chemicals are present or associated with your business is the first of several essential steps to conduct a chemical hazard assessment.

To complete this Section, please follow Steps 1 through 3 described below:

### Step 1 Questionnaire

- Complete Section B (“Chemical Policies and Management”) of Appendix A
- Complete Section C (“MSDS Management”) of Appendix A
- Record here the number of “Yes” answers \_\_\_\_\_ / 25 ...Section B  
\_\_\_\_\_ / 8 ...Section C

👉 **Note:** The questionnaire is set up so that a “YES” answer reflects the ideal state.

👉 **Tip:** “NO” answers indicate areas for improvement.

### Step 2 MSDS Management

- Compile hardcopies of all MSDS for the facility into a binder.
- Transcribe information from the hardcopy MSDSs into an electronic format.

👉 **Note:** Appendix C provides instructions and a suggested format for constructing an electronic MSDS Manager.

👉 **Tip:** To guide improvement in MSDS Management, aim for all “YES” answers to Section C of Appendix A questionnaire.

👉 **Tip:** For help in reading and interpreting MSDSs, see resources provided under the “MSDS” sub-heading of the Resources & Reference Material Section.

### Step 3

### Chemical Inventory

- Compile chemical information from all the MSDSs
- Supplement the MSDS chemical information with additional information obtained from other sources (e.g. air permits, water discharge permits, waste manifestos, suppliers etc.)
- Transcribe all available chemical information into an electronic format.

👉 **Note:** Appendix D provides instructions and a suggested format for constructing an electronic Chemical Manager.

👉 **Tip:** Refer to the EH&S regulatory information that you collected and recorded in Appendix B for possible sources of supplemental chemical information.

## Section IV: Chemical Assessment

This Section provides a step-by-step approach on how to perform a hazard assessment on just the chemicals “flowing” through one or more value streams. The User of this Handbook has the flexibility to select and set the boundaries of the value stream of interest. This might be at the level of a specific product line, a particular manufacturing step, or the whole facility. The latter are examples of boundaries that fall within the category of so-called “gate-to-gate” analyses. However, the approach adopted in this Handbook is deliberately flexible and modular to accommodate a life-cycle analysis of the chemical impacts of a product. Assessments can be performed independently for different value streams encompassing different stages in the life cycle of the product, and the results stacked to provide a more a more complete picture of the chemical impacts of the product. For example, you could work with your supply chain to complete chemical assessments (using this Handbook) of the materials you specify for your product.

This Section describes 11 steps to (i) complete a qualitative chemical assessment based on hazard identification; and (ii) identify opportunities to replace chemicals of concern with more environmentally preferable chemicals. Instructions for each step are provided below:

### **Step 1** Questionnaire

- Complete Section D (“Chemical Assessment Procedures”) of Appendix A
- Record here the number of “Yes” answers \_\_\_\_\_ / 13

👉 **Note:** The questionnaire is set up so that a “YES” answer reflects the ideal state.

👉 **Tip:** “NO” answers indicate areas for improvement.

## Step 2 Select Boundary

- Define the boundary for the chemical assessment. An assessment can be done at the facility-level (i.e. all operations) or for selected product(s), or manufacturing process(es).
- Enter a name for the selected value stream:

- Briefly describe the nature of the selected value stream:

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☞ **Tip:** It is recommended that you start with a value stream that is known or suspected to be a significant environmental aspect with regards to chemical and/or material usage. “Significant” may be defined in terms of volume, number of different chemical or material inputs, or the usage of known or suspected problematic chemicals.

## Step 3 Process Flow Map

- Generate a process flow map to clearly delineate the boundaries of the selected value stream
- Ensure that the process flow map clearly depicts all manufacturing steps and production lines covered by the value stream.

☞ **Note:** Appendix E provides an example of a process flow map and a legend of symbols to depict the various flows and components of a typical production line.

☞ **Tip:** If you are conducting a facility-level chemical assessment, it is recommended that you generate a process flow map for each individual production line or value stream. The facility-level assessment will then be based on the sum of all the individual assessments.

☞ **Tip:** A process flow map is a very useful method to identify and collate information on all the chemical/material inputs and wastes generated for a particular value stream. This information is critical for a thorough chemical assessment.

#### Step 4 Identify chemical and material inputs

- Using the process flow map, identify **all** chemical and material inputs entering the selected value stream.
- To be complete, the inventory should include: (1) product chemicals; (2) process chemicals; and (3) maintenance chemicals. Note that product chemicals are inclusive of raw (starting) materials, components, sub-assemblies etc. entering the value stream (production cell).
- Compile the chemical input information in an electronic format.

👉 **Note:** Appendix F provides a pre-formatted table for capturing the relevant information. Appendix F can also be used to capture the waste (output) information identified through Step 5 (see below).

👉 **Tip:** If the selected value stream is inclusive of multiple production lines, it is recommended that you create a process flow map for each production line, but record all the input data into the same table (i.e. Appendix F)

#### Step 5 Identify all chemical and material outputs

- Using the process flow map, identify **all** chemical and material inputs exiting the selected value stream.
- Outputs are inclusive of the wastes generated **and** the value-added component, assembly or final product manufactured in the selected value stream. **Note:** the value-added output of one production cell may be an input (starting material) for another production cell covered by the selected value stream
- Include all wastes (emissions and releases) produced by the value stream: solid, liquid wastes and air emissions, both hazardous and non-hazardous.

👉 **Note:** Appendix F provides a pre-formatted table for capturing the relevant information.

👉 **Tip:** If the selected value stream is inclusive of multiple production lines, it is recommended that you create a process flow map for each production line, but record all the output data in the same table (i.e. Appendix F)

## **Step 6** Collect MSDS chemical information

- Using the electronic MSDS Manager, search for the MSDSs for all the chemical and material inputs identified in Step 4 above and recorded in Appendix F.
- Flag inputs for which the MSDS is not available or out-of-date
- Obtain copies of missing MSDS or the correct versions of the MSDS by contacting the relevant supplier.
- Use the electronic Chemical Manager to retrieve only the chemical information for the applicable MSDSs.
- Type or copy the chemical name and CASRN of the selected chemicals into Appendix G (See Step 8)

## **Step 7** Collect waste chemical identification

- Update the electronic Chemical Manager with data on the chemical composition of the wastes generated in the value stream.
- Type or copy the chemical name and CASRN of the selected chemicals into Appendix G (See Step 8)

☞ **Tip:** Chemical information regarding wastes may be contained within the regulatory reporting documents identified and recorded in Appendix B (e.g. air permits, water discharge permits, waste manifestos etc.)

## **Step 8** Generate Chemical List

- Generate a list of the all chemicals associated with the selected value stream, by compiling the chemical information obtained in Step 7 and Step 8 into a new matrix.
- Clean up the list by removing duplicate entries (i.e. chemicals with the same name and CASRN) and/or chemicals that do not have a true CASRN (i.e. the CASRN field contains “none”, “undisclosed”, “proprietary” etc., or a trade association number).
- This list now provides a snapshot of the “chemical footprint” of the value stream and can be used to perform a hazard assessment (See Step 9).

☞ **Note:** Appendix G provides a pre-formatted table for capturing the relevant information. The same table can then be used to record the results of the hazard assessment (see Step 9).

☞ **Tip:** It is difficult to conduct a hazard assessment on chemicals that do not have a correct or true CASRN.



## **Step 9** Perform Hazard Assessment

- Screen the list generated in Step 8 for problematic chemicals (so-called “chemicals of concern” using a hazard identification approach. This is not meant to be a risk assessment, but an initial and internal screen to flag chemicals of concern. Flagging is useful to prioritize chemicals for follow-up considerations.
- Select which human health and/or ecosystem health end-points to include in the assessment. Examples are provided in Appendix G.
- Record the results of the hazard assessment for each chemical by placing an X in the appropriate end-point column of Appendix G. Chemical assessment resources & tools are provided under the “Chemical Assessment” sub-heading of the Resources & Reference Materials Section.
- Any chemical demarcated with one or more “X” becomes a potential chemical of concern for the selected value stream. A more detailed assessment of dose and exposure routes may be necessary to determine if the chemical truly represents cause for concern under the conditions it is being used in the selected value stream.

👉 **Note:** Appendix G provides a pre-formatted table and instructions for capturing the results of the hazard assessment.

## **Step 10** Identify opportunities for Green Chemistry

- Identify opportunities to reduce the use of chemicals of concern or replace them (substitute) with safer alternatives.

👉 **Note** Some tools & resources to help identify safer chemicals for products and processes are provided under the “Green Chemistry” in the Tools Section of the Handbook.

## **Step 11** REPEAT

- Repeat Steps 1-10 for additional value streams: The chemical assessment protocol outlined in Steps 1 through 10 is a modular approach. As interest and resources allow, repeat the process for additional value streams to ultimately create a “chemical footprint” and “chemicals of concern” list for the entire facility.

## Section V: Acronyms & Definitions

This Section provides a list of definitions for key terms and acronyms used in the Handbook.

**Carcinogen:** A chemical, physical or biological agent that is capable of inducing the development of cancer from normal cells or promoting the growth of a cancer.

**CASRN:** Chemical Abstracts Service Registry Number; a unique numeric identifier assigned to a chemical compound by the Chemical Abstracts Service, a division of the American Chemical Society.

**Chemical of concern:** A chemical that makes a significant impact on human health and/or ecosystem health by contributing to one or more life cycle impact categories.

**Design for the Environment (DfE):** The systematic integration of life-cycle environmental considerations into the design and development of products and processes.

**Endocrine disruptor:** a chemical that can interfere with the endocrine system by mimicking, blocking or otherwise disrupting the function of hormones.

**Environmental aspect:** An element of an organization's activities, products or services that can interact with the environment.

**Environmental management system:** The part of a company's overall management system that includes organizational structure, planning activities, responsibilities, practices, procedures, processes, and resources for developing, implementing, achieving, reviewing, and maintaining the environmental policy.

**Life Cycle:** A series of inter-connected phases or stages covering the life of a product or service, including raw material acquisition, pre-manufacturing, manufacturing, distribution, use and reuse, and end-of-life management.

**Maintenance chemical:** A chemical not directly used in the manufacturing of the product (e.g. forklift engine oil).

**MSDS:** Material Safety Datasheet; a document required by the OSHA Hazard Communication Standard that provides data on the physical and toxicological properties and storage, handling and disposal information of any reportable hazardous chemicals present within a product.

**Persistent, Bioaccumulative and Toxic (PBT) chemical:** a toxic chemical with a propensity to remain unchanged in the environment for long periods, and accumulate in the tissue of biological organisms such that the tissue level of the chemical is higher than that in the surrounding environment.

**Process chemical:** a chemical used in the direct manufacturing of the product and not intended to be incorporated into the product (e.g. preparation solvent prior to powder coating).

**Product chemical:** a chemical incorporated in or on the product (e.g. particleboard, wood finish).

**Reproductive toxicant:** a chemical that can interfere with the normal functioning of the reproductive system and sexual behavior of exposed individuals, and/or can result in the death or impaired development of a fetus during pregnancy.

**Significant environmental aspect:** an environmental characteristic that has or can have significant environmental impact.

**Value stream:** a defined set of activities whereby an organization provides value in the form of a product or service.

**Value stream mapping:** a technique used in LEAN manufacturing to analyze the flow of materials and information currently required to bring a product or service to a consumer.

## Section VI: Resources & Reference Materials

### ENVIRONMENTAL, HEALTH & SAFETY REGULATIONS

- Michigan Department of Environmental Quality *Community Right to Know* webpage  
[http://www.michigan.gov/deq/0,1607,7-135-3307\\_29815---,00.html](http://www.michigan.gov/deq/0,1607,7-135-3307_29815---,00.html)

A PDF document summarizing general reporting requirements for Emergency & Hazardous Chemical Inventory Reporting:

[http://www.michigan.gov/documents/deq/deq-ess-sara-311-312\\_217878\\_7.pdf](http://www.michigan.gov/documents/deq/deq-ess-sara-311-312_217878_7.pdf)

A PDF document summarizing Spill/Release Notification requirements:

<http://www.deq.state.mi.us/documents/deq-ead-sara-releasetable.pdf>

- Michigan Department of Environmental Quality *Hazardous Waste Management* webpage  
[http://www.michigan.gov/deq/0,1607,7-135-3312\\_4118\\_4240---,00.html](http://www.michigan.gov/deq/0,1607,7-135-3312_4118_4240---,00.html)
- Michigan Manufacturers' Guide to Environmental, Health and Safety Regulations (Fifth Edition); Michigan Department of Environmental Quality and Michigan Department of Labor and Economic Growth; June 2004

The entire guide is available in PDF format at:

<http://www.deq.state.mi.us/documents/deq-ess-caap-manufguide-all.pdf>

The Facility-Assessment Survey is available in PDF format at:

<http://www.deq.state.mi.us/documents/deq-ess-caap-manufguide-assessmentsurvey.pdf>

- MIOSHA General Industry Safety & Health Standards; Available on-line at:  
[http://www.michigan.gov/dleg/0,1607,7-154-11407\\_15368\\_23451---,00.html](http://www.michigan.gov/dleg/0,1607,7-154-11407_15368_23451---,00.html)

### CHEMICAL MANAGEMENT & HAZARD COMMUNICATION

- Michigan Business Pollution Prevention Partnership  
[http://www.michigan.gov/deq/0,1607,7-135-3585\\_4129\\_4188---,00.html](http://www.michigan.gov/deq/0,1607,7-135-3585_4129_4188---,00.html)
- Michigan Clean Corporate Citizen program; [www.michigan.gov/deqc3](http://www.michigan.gov/deqc3)
- National Environmental Performance Track (US EPA); [www.epa.gov/perftrac](http://www.epa.gov/perftrac)
- National Fire Prevention Association (NFPA): NFPA 704 Hazard Identification
- National Paint and Coatings Association, Inc. (NPCA): HMIS® III - Hazardous Materials Identification System (Third Edition)
- National Pollution Prevention Roundtable; [www.p2.org](http://www.p2.org)
- *NIOSH Pocket Guide to Chemical Hazards*; Available on-line and as PDF at:  
<http://www.cdc.gov/niosh/npg/>

## CASRN AND MATERIAL SAFETY DATA SHEETS

- Chemical Abstracts Service (CAS)
  - A division of the American Chemical Society; maintains and sells a database of all chemicals with assigned CAS Registry Numbers, the CAS Registry. [www.cas.org](http://www.cas.org)
- On-line searchable tools for locating MSDS:
  - <http://www.ilpi.com/msds>
  - <http://hazard.com/msds/>
- MSDS reportable chemicals as defined by OSHA 29 CFR 1910.1200
  - [http://www.osha.gov/pls/oshaweb/owadisp.show\\_document?p\\_table=STANDARDS&p\\_id=10099](http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10099)
- A guide on how to read an MSDS is included in Appendix E of the Michigan Manufacturer's Guide cited above, and is available in PDF format at:
  - <http://www.deq.state.mi.us/documents/deq-ess-caap-manufguide-appne.pdf>

## CHEMICAL ASSESSMENT TOOLS

The following are a list of tools available to perform a precursory screening of chemicals for potential hazard. The tools include "authoritative" lists, databases and predictive Structure-Activity Relationship modeling programs.

### 1. Carcinogens

#### (A) International Agency for Research on Cancer (IARC)

IARC, a part of the World Health Organization, researches and classifies chemicals on the basis of their carcinogenic potential. Chemicals are rated as:

Group 1:	Carcinogenic to humans
Group 2A:	Probably carcinogenic to humans
Group 2B:	Possibly carcinogenic to humans
Group 3:	Not classifiable as to carcinogenicity to humans
Group 4:	Probably not carcinogenic to humans

A list of chemicals classified currently rated by IARC, and arranged by CASRN, is available at: <http://monographs.iarc.fr/ENG/Classification/ListagentsCASnos.pdf>

## **(B) California Proposition 65**

The Office of Environmental Health Hazard Assessment (OEHHA) of the California Environmental Protection Agency (CA-EPA) is required per the Safe Drinking Water and Toxic Enforcement Act of 1986 to publish a list of chemicals known to the State of California to cause cancer.

The most current version of this list is available at:  
[http://www.oehha.ca.gov/prop65/prop65\\_list/Newlist.html](http://www.oehha.ca.gov/prop65/prop65_list/Newlist.html)

OEHHA also publishes No Significant Risk Levels (NSRL) for Carcinogens reported on the Proposition 65 list. The most current version of the NSRL values is available at:  
<http://www.oehha.ca.gov/prop65/getNSRLs.html>

## **(C) National Toxicology Program (NTP)**

The NTP annually publishes a *Report on Carcinogens* (ROC). This report is divided into two parts: Part A – Chemicals classified as “Known to be a Human Carcinogen”; Part B – Chemicals classified as “Reasonably Anticipated to be a Human Carcinogen”. The 11<sup>th</sup> report is the most recent version.

Part A is available at: <http://ntp.niehs.nih.gov/ntp/roc/eleventh/known.pdf>  
Part B is available at: <http://ntp.niehs.nih.gov/ntp/roc/eleventh/reason.pdf>

## **2. Reproductive and Developmental Toxicants**

### **(A) California Proposition 65**

The Office of Environmental Health Hazard Assessment (OEHHA) of the California Environmental Protection Agency (CA-EPA) is required per the Safe Drinking Water and Toxic Enforcement Act of 1986 to publish a list of chemicals known to the State of California to cause reproductive toxicity.

The most current version of this list is available at:  
[http://www.oehha.ca.gov/prop65/prop65\\_list/Newlist.html](http://www.oehha.ca.gov/prop65/prop65_list/Newlist.html)

OEHHA also publishes Maximum Allowable Dose Levels (MADL) for Reproductive Toxicants reported on the Proposition 65 list. The most current version of the NSRL values is available at:  
<http://www.oehha.ca.gov/prop65/getNSRLs.html>

### **(B) EU Consolidated List of Carcinogenic, Mutagenic and Reproductive Toxicant Substances**

Through EC Directive 76/769/EEC, the European Commission of the European Union has published a list of chemicals identified as being “toxic to reproduction”, either category 1 or category 2. This list is available at:  
[http://ec.europa.eu/enterprise/chemicals/legislation/markrestr/1976l0769\\_en\\_03\\_10\\_2007.pdf](http://ec.europa.eu/enterprise/chemicals/legislation/markrestr/1976l0769_en_03_10_2007.pdf)

### 3. Persistent, Bioaccumulative and Toxic Chemicals (PBT)

#### (A) US EPA PBT Final Rule

Certain (PBT) chemicals are subject to reporting under section 313 of the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) and section 6607 of the Pollution Prevention Act of 1990 (PPA). In 1999, the US EPA published a Final Rule in the Federal Register, Vol. 64, No. 209. Table 1 and Table 3 list the PBT chemicals.

US EPA (1999) Federal Register, Part VII, 40 CFR 372 Persistent Bioaccumulative Toxic (PBT) Chemicals; Final Rule, Vol. 64, No. 209, Friday, October 29, 1999; is available at:  
<http://www.epa.gov/fedrgstr/EPA-WASTE/1999/October/Day-29/f28169.htm>

#### (B) PBT Profiler

The PBT Profiler, courtesy of the Office of Pollution Prevention and Toxics (US EPA), is a predictive tool based on Structure-Activity Relationship (SAR) modeling that can be used to screen chemicals for persistence, bioaccumulation, and toxicity to aquatic life, in the absence of experimental data. The PBT Profiler cannot be used to assess all chemicals, notably metals and metal-containing chemicals.

The PBT Profiler is available on-line at: <http://www.pbtprofiler.net/default.asp>

### 4. Endocrine Disruptors

The European Commission has published a report reviewing the potential for chemicals to cause endocrine disruption in humans and wildlife.

The report, "*Towards the establishment of a priority list of substances for further evaluation of their role in endocrine disruption* [Final Report 2000]", is available on-line at:  
[http://ec.europa.eu/environment/docum/pdf/bkh\\_annex\\_13.pdf](http://ec.europa.eu/environment/docum/pdf/bkh_annex_13.pdf)

### GREEN CHEMISTRY RESOURCES

- US EPA Green Chemistry Program; <http://www.epa.gov/greenchemistry/>
- Green Chemistry Institute of the American Chemical Society;  
<http://chemistry.org/greenchemistryinstitute>
- Green Chemistry Resource Exchange; <http://www.greenchemex.org/about>
- Green Chemistry Expert System; <http://www.epa.gov/greenchemistry/pubs/tools.html>

## Appendix A: Questionnaire

*Please answer the following questions by checking either the "Yes" or "No" box*

■ Section A: Rules & Regulations	Yes	No
• Is the company familiar with all local, state, federal regulations/laws pertaining to Environment, Health and Safety (EH&S) to which it must demonstrate compliance?	<input type="checkbox"/>	<input type="checkbox"/>
• Does the company keep track of pending chemical regulations and new standards for chemical product use?	<input type="checkbox"/>	<input type="checkbox"/>
• Has the company been free from any significant EH&S-related non-compliance violations in the last three years?	<input type="checkbox"/>	<input type="checkbox"/>
• Is the company free from any pending or unresolved EH&S-related notices of violation with local, state or federal agencies?	<input type="checkbox"/>	<input type="checkbox"/>
• Have all point source (and non-point source) emission units secured the appropriate permits from regulatory agencies?	<input type="checkbox"/>	<input type="checkbox"/>
• Has the company been free of any large spills or releases that were non-routine in nature within the past year?	<input type="checkbox"/>	<input type="checkbox"/>
• Does the company have a designated EH&S officer or staff person that is responsible for regulatory compliance matters?	<input type="checkbox"/>	<input type="checkbox"/>
• Is all compliance-related documentation centrally organized and stored, backed-up, and easily accessible?	<input type="checkbox"/>	<input type="checkbox"/>
• Does the company engage the surrounding community around any concerns about chemical use and/or emissions/releases at its facilities?	<input type="checkbox"/>	<input type="checkbox"/>
■ Section B: Policies and Management	Yes	No
• Does the company have publicly available statements describing the company's policies towards environmental issues and chemicals of concern that impact human and ecosystem health?	<input type="checkbox"/>	<input type="checkbox"/>
• Do the policies take a life-cycle perspective of potential human health and ecosystem health impacts?	<input type="checkbox"/>	<input type="checkbox"/>
• Does the company have a formal Environmental Management System (EMS)?	<input type="checkbox"/>	<input type="checkbox"/>
• Is the EMS third-party certified?	<input type="checkbox"/>	<input type="checkbox"/>
• Are any of the company's facilities ISO 14001-certified?	<input type="checkbox"/>	<input type="checkbox"/>
• Does the company have Michigan Clean Corporate Citizen status?	<input type="checkbox"/>	<input type="checkbox"/>



- Is the company a member of the National Environmental Performance Track program? ☐ ☐
- Is the company enrolled in the Michigan Business Pollution Prevention Partnership (MBP3) ☐ ☐
- Is the company a member of a Pollution Prevention Roundtable (National or Great Lakes Regional)? ☐ ☐
- Does the company have a formal chemical management plan? ☐ ☐
- Does the company have a formal chemical hygiene plan? ☐ ☐
- Does the company have a written hazard communication plan which is readily available and communicated to employees? ☐ ☐
- Are products containing reportable hazardous chemicals flagged and the potential hazard communicated to employees? ☐ ☐
- Are products containing IARC/OSHA/CAP65/NTP reportable carcinogens and reproductive toxicants flagged and the potential hazard communicated to employees? ☐ ☐
- Is a list of all hazardous chemicals used in the work place posted for employees to reference? ☐ ☐
- Are all chemicals clearly labeled and posted with applicable hazard warnings? ☐ ☐
- Are hazard communication placards, describing NFPA or HMIS ratings, posted in areas where chemicals/materials are stored and used? ☐ ☐
- Are staff trained to read, interpret and understand hazard communication placards? ☐ ☐
- Do employees understand the difference between acute exposure reactions and chronic health problems? ☐ ☐
- Do employees understand that exposure can occur by a number of different routes, including inhalation, ingestion, and by skin or eye contact? ☐ ☐
- Do employees understand and always use the proper Personal Protective Equipment (PPE) to protect themselves? ☐ ☐
- Does the company have a general environmental training program? ☐ ☐
- Does the company have a formal environmental risk reduction training program? ☐ ☐
- Are the employees trained to react to spills and other environmental incidents? ☐ ☐
- Has the company created a formal dialog to discuss the environmental risks with the surrounding community? ☐ ☐

■ Section C: MSDS Management	Yes	No
• Have MSDS for all applicable chemicals and materials been collected, organized and stored in a central location?	<input type="checkbox"/>	<input type="checkbox"/>
• Is there a system for updating MSDS to the most recent version and removing defunct MSDS?	<input type="checkbox"/>	<input type="checkbox"/>
• Has the company assigned responsibility of MSDS management to a particular staff member(s)?	<input type="checkbox"/>	<input type="checkbox"/>
• Are the MSDS organized to any particular system? (For example: alphabetically, numerically, by supplier, by value-stream?)	<input type="checkbox"/>	<input type="checkbox"/>
• Has an electronic database of all MSDS been created?	<input type="checkbox"/>	<input type="checkbox"/>
• Are the hard-copies and electronic database accessible to all staff, without having to ask for assistance or consult with a supervisor?	<input type="checkbox"/>	<input type="checkbox"/>
• Have employees received training on how to read, interpret and understand an MSDS?	<input type="checkbox"/>	<input type="checkbox"/>
• Will your employees be able to satisfy an OSHA inspector that they understand the basic information of an MSDS and chemical hazards?	<input type="checkbox"/>	<input type="checkbox"/>

■ Section D: Chemical Assessment Procedures		Yes	No
• Has the company requested additional chemical information from suppliers other than that provided in the MSDS?	<input type="checkbox"/>	<input type="checkbox"/>	
• Are the company's customers requesting additional chemical information on the company's products?	<input type="checkbox"/>	<input type="checkbox"/>	
• Does the company track and record chemical/material usage?	<input type="checkbox"/>	<input type="checkbox"/>	
• Does the company track and record the quantities of liquid and solid wastes generated and air emissions released?	<input type="checkbox"/>	<input type="checkbox"/>	
• Does the company have a chemical assessment protocol?	<input type="checkbox"/>	<input type="checkbox"/>	
• Does the chemical assessment protocol take a life-cycle perspective to help avoid unintended consequences of chemical substitutions?	<input type="checkbox"/>	<input type="checkbox"/>	
• Does the company have a chemical use reduction strategy?	<input type="checkbox"/>	<input type="checkbox"/>	
• Have products containing MSDS reportable hazardous chemicals been considered for possible elimination, reduction or substitution?	<input type="checkbox"/>	<input type="checkbox"/>	
• Have products containing MSDS reportable carcinogens and reproductive toxicants been considered for possible elimination, reduction or substitution?	<input type="checkbox"/>	<input type="checkbox"/>	
• Does the company assess the human health and ecosystem health impacts of chemicals that are not regulated and/or not reportable on the MSDS?	<input type="checkbox"/>	<input type="checkbox"/>	
• Is the company familiar with the 12 principles of Green Chemistry?	<input type="checkbox"/>	<input type="checkbox"/>	
• Has the company successfully substituted any problematic chemicals with safer alternatives?	<input type="checkbox"/>	<input type="checkbox"/>	
Does the company have a Design for the Environment program or any other program that includes procedures and protocols for assessing chemicals for any potential human health and ecosystem health impacts?	<input type="checkbox"/>	<input type="checkbox"/>	

**Appendix B:**  
**Table of EHS Regulations and Reporting Requirements**


[illegible]

## Appendix C: Electronic MSDS Manager

Trade Name	Manufacturer	MSDS (Y/N)	Issue Date	Most current version (Y/N)	Storage Location	Function	Operation	Product-, Process- or Maintenance chemical?	Department / Cell #	Product Line/ Value Stream	Regulatory Issues	HMIS III Rating				NFPA Rating			
												Health	Flammability	Physical Hazard	Personal Protection	Health	Flammability	Reactivity	Special Hazard

### Instructions:

1. Create a spreadsheet (e.g. Microsoft Excel). Suggested column headings are shown above.
2. Complete each field using information obtained from the MSDS. An explanation of each heading is provided below.

 **Tip:** Use the filter function within the spreadsheet to sort the MSDS Manager for any field of interest (e.g. all product-level MSDSs, or all MSDSs for cell #3)

**Trade Name:** the registered name of the product covered by the MSDS (the “MSDS product”).

**Manufacturer:** the manufacturer of the MSDS product.

**MSDS (Y/N):** confirm with a “Yes” or “No” that there a hard copy of this MSDS has been filed.

**Issue Date:** enter the date stamp of the MSDS.

**Most current version (Y/N):** confirm with a “Yes” or “No” that the filed MSDS is the most current version released by the manufacturer and/or accurately reflects the nature of the product currently being used.

**Storage location:** indicate where the MSDS product is stored. This location may be a designated chemical storage area, the general inventory area or within the production cell(s) where it is used.

**Function:** give a general description of the function(s) of the MSDS product (e.g. urethane polyol).

**Operation:** indicate the operation(s) where the MSDS product is used (e.g. urethane molding).

**Product-, Process-, or Maintenance chemical:** indicate whether the MSDS product is used at the product-, process- or maintenance-level (See glossary for definition of terms). Note that it may be used at more than one level (e.g. product and process level). Note: “product-level” refers to the product manufactured by your company and not the MSDS product.

**Department/Cell #:** list all the departments or cells where the product covered by the MSDS is used. Indicate by name or number (#).

**Product line/Value stream:** list all the product lines or value stream where the MSDS product is used. Note: “product line” refers to the product manufactured by your company and not the MSDS product.

**Regulatory issues:** record any regulatory issues pertaining to the use of the MSDS product by your company. Note: information in this field should cross-reference with the Table of EHS Regulations compiled under section II of the Guide

**Hazard Rating:** Complete the hazard rating categories for HMIS III and/or NFPA recorded on the MSDS. The blue, red and yellow fields will be a number from 0 to 4; the white fields will be a symbol.


 **Note:** Chemical information provided on the MSDS is not compiled in the electronic MSDS Manager, but rather is added to the electronic Chemical Manager

## Appendix D: Electronic Chemical Manager

Trade Name	Chemical Name	CASRN	Quantity	Data Source	Operation	Product Line / Value Stream	Department/ Cell #	Regulatory issues

### Instructions:

1. Create a spreadsheet (e.g. Microsoft Excel). Suggested column headings are shown above.
2. Complete each field using information obtained from the MSDS and/or supplemental chemical information. An explanation of each heading is provided below.

 **Tip:** Use the filter function within the spreadsheet to sort the Chemical Manager for any field of interest (e.g. all chemicals in a given MSDS, all MSDSs with a given chemical, all chemicals used in a specific operation, etc.)

**Trade Name:** the registered name of the product covered by the MSDS (the “MSDS product”). Note: this field links the Chemical Manager with the MSDS Manager

**Chemical Name:** enter the name of each chemical listed on the MSDS or other data source. Note: (1) use one row for each chemical; (2) if no chemical information is provided or the name of the chemical is not disclosed, type “none” or “undisclosed” respectively.

**CASRN:** enter the CASRN (see glossary) of each chemical in the format XXXX-XX-X (for example the CASRN for formaldehyde is 50-00-0). Note: (1) if a CASRN is not provided, type in “none”, “non-specified”, or “proprietary” as may be the case; (2) if a CASRN has been replaced with an internal trade number, type in the latter.

**Quantity:** indicate how much of the chemical is in the product by entering a numeric value *plus* units. Note: units may be % w/w, % w/v, ppm or mg/ml etc.

**Data Source:** enter “MSDS” if the chemical information was obtained from the MSDS. Note: additional chemical information could be obtained from supplemental sources such as the supplier, air permits; waste manifests, etc.; if this is the case, enter “supplier” for example.

**Operation:** indicate the operation(s) where chemical is used. Note: this will be same operation identified for the MSDS product in the MSDS Manager (e.g. urethane molding).

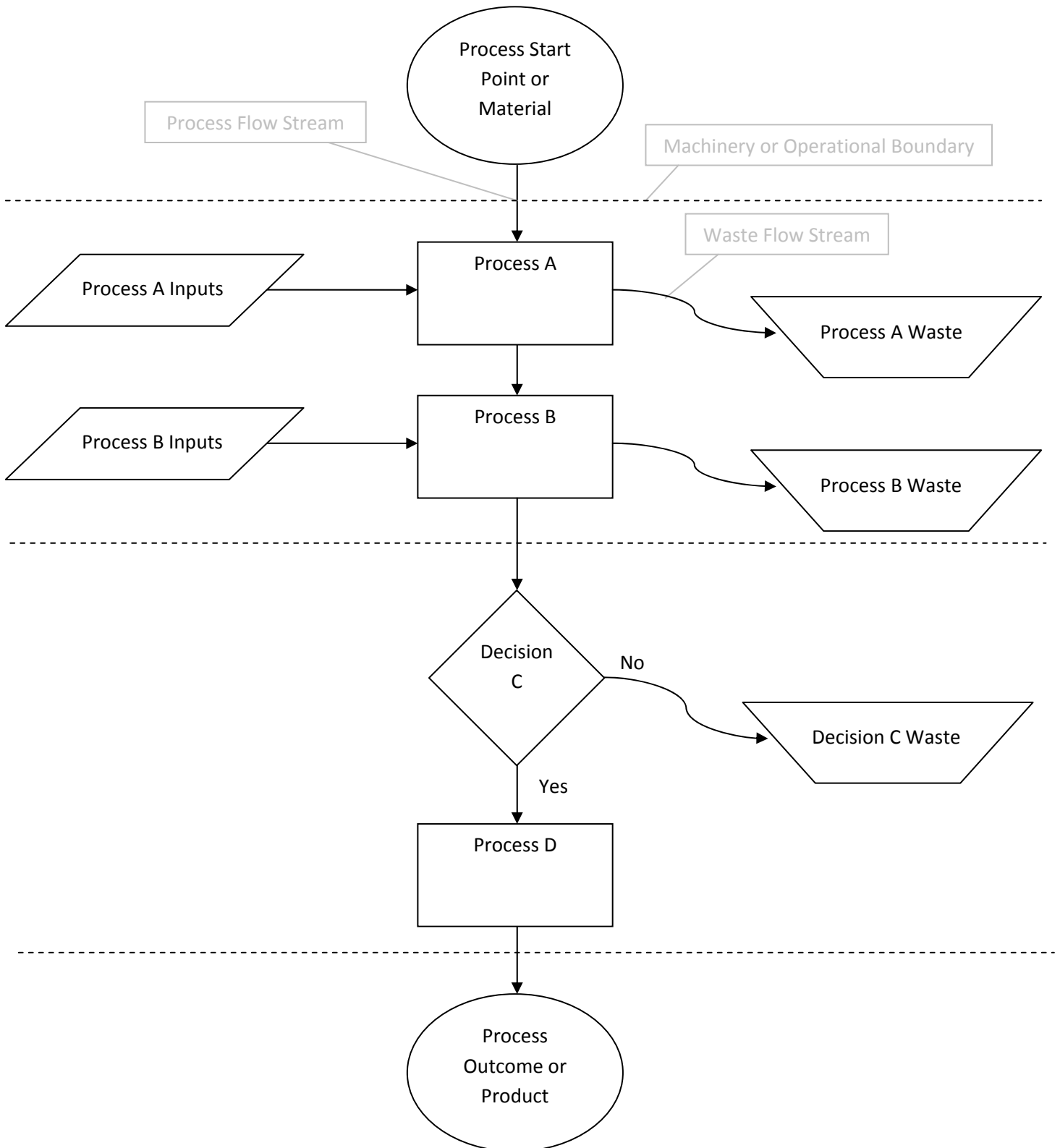
**Department/Cell #:** list all the departments or cells where the chemical is used. Indicate by name or number (#). Note: these will be the same locations specified for the MSDS product in the MSDS Manager (e.g. cell #3)

**Product line/Value stream:** list all the product lines or value stream where the chemical is used. Note: these will be the same product lines/value streams specified for the MSDS product in the MSDS Manager.

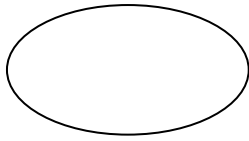
**Regulatory issues:** record any regulatory issues pertaining to the storage, use and disposal of the specific chemical. Note: this field covers regulatory issues for each individual chemical and not the MSDS product as a whole.

## Appendix E: Generic Process Flow Chart

Name of Value Stream: \_\_\_\_\_



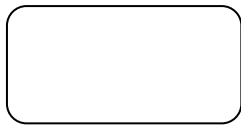
## Legend:



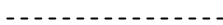
**Process Start/Outcome** – Represents the beginning and ending points of the overall process. Usually begins with the primary starting component and ends with the finished product or process output.



**Process** – A manual process is anything that requires a person to perform the primary function of the operation. This could include loading, unloading, fastening, assembly, cleaning, etc.



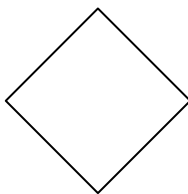
**Automated Process** – An automated process is any function that a machine performs the primary function without significant user input. User input required to initiate the process, i.e. push a button, is not considered significant user input. Automated processes include forming, stamping, heating, washing, etc.



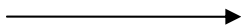
**Machinery or Operational Boundary** – This boundary line indicates the boundaries of a machine or process operation. It is a method of grouping several process steps within the larger context of which they exist.



**Process Input** – Process inputs is primarily all material inputs added during each operation. They include materials both product and process level materials. Heat can also be included as a process input.



**Decisions** – Represents a point where the process flow diverges. The direction of process flow is dependent upon the decision made at this point.



**Process Flow Stream** – Process flow stream indicates the flow path along which the material inputs and process flow travel. This flow path should always travel from the process start and material inputs and end at the process outcome.



**Waste Flow Stream** – A squiggly line indicates waste stream flow. Unique identification of waste stream flow differentiates these streams from primary process flow.



<b>Appendix F:</b> <b>Process Flow Map - Chemical &amp; Material Inputs &amp; Wastes</b>
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Name of value stream:

[illegible]

## Appendix G: Hazard Identification Matrix

Chemical list for: _____		Human & Ecosystem health end-points												
Chemical Name	CASRN	carcinogen	mutagen	reproductive toxicant	endocrine disruptor	respiratory sensitizer	skin sensitizer	PBT	aquatic toxicity	terrestrial toxicity	greenhouse gas	ozone depleting substance	smog-forming chemical	Other

### Instructions:

1. Create a spreadsheet (e.g. Microsoft Excel). Suggested headings are shown above.
2. Sort the Chemical Manager for the desired chemical list and copy and paste into this matrix.
3. In the field "Chemical list for", indicate whether the chemical list generated represents all chemicals for a facility, or chemicals for a specific process or a specific product etc.
4. Perform the hazard identification. Screen each chemical for potential hazards using the resources provided in Section X.

☞ Tip: Use the filter function within the spreadsheet to sort the matrix for any field of interest (e.g. all carcinogens, all PBTs etc.)

**Chemical Name** and **CASRN**: Transfer chemical information from the Chemical Manager such that there is only one entry for each unique chemical (as determined by CASRN and/or chemical name).

**Human & ecosystem health end-points**: Select the end-points of interest and label the column headings accordingly (Examples of possible end-points are shown above). Conduct the hazard identification and, where applicable, place an X under each appropriate end-point for each chemical.

☞ Tip: Filter the spreadsheet for only those chemicals that have one or more Xs; this produces a subset of "**Chemicals of Concern**" for the specified level (facility, product, process etc.)

☞ **Note**: Single or multiple human health and ecosystem health impacts may be identified for a chemical even if no regulatory issues for that chemical were noted on the MSDS and recorded in the Chemical Manager.